

INTRODUCTION

As a supplement to the sampling and petrographic study of exposed basement rocks in the Salinian block, I was able to obtain basement samples from a number of oil wells that were drilled to basement. This material has greatly extended the areas within the Salinian block where the basement can be identified. Two significant blank areas remain along the west side of the block where wells have not yet penetrated the thick "overburden"—south of the Santa Lucia Range, and south of the La Panza Range. This is particularly unfortunate because the relations between the granitic basement and Franciscan basement to the west are critical to regional interpretations.

Identification of these subsurface samples not only increases the knowledge of the extent of the Salinian basement, but contributes information about some more specific problems. Samples between the La Panza and Gabilan Ranges, particularly those of the San Ardo oil field area, essentially "close the gap" between the ranges and fortify a previous suggestion (Ross, 1972a) that there is a dominantly granitic belt to the Salinian block. Also, the abundant samples of a gneissic nature southeast of Barrett Ridge add to the evidence for the existence of the proposed Barrett Ridge slice (Ross, 1972a) which is dominantly metamorphic rock in contrast to the dominantly granitic central core of the Salinian block. In addition, a number of mica schist samples from the San Ardo area (as well as some from west and south of the Gabilan Range) are strikingly similar to a vast, monotonous schist terrane in the eastern Santa Lucia Range (schist of Sierra de Salinas). The occurrence of these rocks, which chemically and physically resemble a great pile of graywacke, is unusual in the Salinian block.

PETROGRAPHY

Thin sections of all the samples listed on table 1 were studied and, where possible, modal point counts were made of stained slides from these core samples (tables 2, 3). For the ditch samples (asterisked on table 1), larger fragments were handpicked, mounted in plastic, and a thin section was cut from the plastic-impregnated mass.

Petrographic data have been published for the La Panza, Johnson Canyon, Vergeses, and Ben Lomond granitic units (Ross, 1972a,b). The schist of Sierra de Salinas will be described in a separate report. Some petrographic notes are presented for other units distinguished on sheet 1 and for samples that have no correlative equivalent in outcrop.

Subsurface granitic units of the San Ardo oil field area

More than 100 wells in the San Ardo field reached basement, but core material is available for about 20. Nevertheless, a generalized pattern of basement rock distribution has been worked out (sheet 1). Granitic rocks that are probably correlative with the granitic mass in the La Panza Range make up the southeast extremity of the San Ardo area. Much in common with the rather extensive hornblende-bearing quartz diorite and granodiorite of the San Ardo area. Between these two units that have presumed outcrop equivalents are three granitic units that have none (fig. 1).

The most widespread unit is hornblende-bearing quartz diorite and granodiorite that is represented by samples 48, 62, 92, 96a, 109, 114, 129, 131, 133, 138, and 130 and 136 (table 1). The rock is characterized by well-twinned, weakly zoned, intermediate to sodic andesine; largely untwinned K-feldspar; sutured and mosaicked quartz that is locally granulated; and shiny black dark minerals that in this section are the typical olive-brown biotite and olive-green hornblende. Some of the dark minerals are well formed, but others are streaky and patchy. Sphene seems to be widespread, as are the associated accessories zircon, apatite, and allanite. Magnetite, though common locally, is absent from several specimens—a characteristic of the Salinian block. Alteration of hornblende is common, and some grains are completely pseudomorphed by chlorite and epidote. The overall petrographic character of this rock is generally similar to the Johnson Canyon unit except the San Ardo rock has more K-feldspar, but the fact that only a dozen or so small samples from the San Ardo unit have been examined makes this a tenuous correlation at best.

The map pattern suggests that the peppery quartz monzonite represented by samples 94, 96a, 99, 108, and 110 (table 1) intrudes the hornblende-bearing unit, but there is no direct evidence of age relations. The quartz monzonite specimens are in part shattered and brecciated, particularly in the west, and are widespread; in some areas, the dark minerals are completely altered to chlorite and calcite, and leucocratic skeletons replace sphene. Metallic opaque grains seem abundant than in the hornblende-bearing unit, but many of these grains are by-products of the dark-mineral alteration. The most characteristic feature of this quartz monzonite is the peppery scattering of dark mineral grains.

Two samples from east of the oil field (Nos. 140 and 144) are somewhat unusual because they contain considerably more hornblende than biotite, and only a small amount of quartz. They contain untwinned K-feldspar and weakly zoned sodic andesine that is much dusted and shattered. The dark minerals are commonly altered to mixtures of chlorite, epidote, and calcite. Both sphene and metallic opaque crystals are widespread and common. Some of the metallic grains are obvious alteration by-products, but others are larger and definitely primary.

The peppery quartz monzonite and the hornblende-rich units have no correlative in the exposed basement. The peppery quartz monzonite has some resemblance to the detrital unit of Neiverville in the Gabilan Range (Ross, 1972) and the quartz-poor hornblende-rich unit may be a local variant of the more widespread hornblende-bearing quartz diorite and granodiorite.

Subsurface equivalents of the gneissic rocks of Red Hills and Barrett Ridge

Although this unit is treated essentially as a formation on sheet 1, in reality it is more a mixed terrane of metamorphic and granitic rocks characterized by relatively high grade gneissic rocks. Outcrops at Red Hills, Barrett Ridge, and the Mount Abel-Mount Pinos area have been described by Ross (1972a). At Red Hills the rocks have mostly been hominitized to dark green gneiss, but abundant gneissic rocks are present. In contrast, at Barrett Ridge the rocks are dominantly gneissic and are associated with alkali. Homogeneous granitic rocks are found in the core samples in this terrane (for example, RS-184c, 212a, and 210b) but invariably they are closely associated with gneissic rocks. Other felsic granitic rocks like RS-197 and 224 have rather irregular textures and contrast strongly with the widespread and homogeneous granitic rocks of the La Panza Range area, west of the Barrett Ridge slice.

The following petrographic notes on some of the metamorphic rocks from the core samples show the comparisons with the exposed gneissic rocks.

RS-182: A gneissic rock with much dark-red staining and green-smears surfaces; some brecciation. Composed largely of sodic andesine, abundant untwinned K-feldspar and quartz. Trains of chloritized olive-brown biotite associated with calcite and metallic opaque minerals define a cline of pink K-feldspar, epidote, and calcite. Similar coarse hornblende grains with associated pegmatite are found at Red Hills.

RS-187: Coarse-grained plagioclase amphibolite cut by dikes of pink K-feldspar, epidote, and calcite. Similar coarse hornblende grains with associated pegmatite are found at Red Hills.

RS-194: Irregular textured, somewhat "meared" granitic rock with fine-grained hornfels layer. Mostly dusty twinned andesine with smaller amounts of K-feldspar and quartz. Much iron-stained brown biotite and abundant aggregates of chlorite or serpentine and calcite that at least in part pseudomorph hornblende. Some resemblance to ghost gneiss of Red Hills and quite unlike La Panza basement.

RS-198: Gray-green gneiss to granofels with poor foliation. Granoblastic aggregate of twinned sodic andesine, untwinned K-feldspar, sutured quartz, partly chloritized brown biotite, magnetite, and rounded (detrital?) zircon.

RS-200: Felsic pinkish rock that has a dominantly granitic texture but with streaky, gneissic patches emphasized by biotite concentrations and, on stained surfaces, by K-feldspar-rich layers. Composed of well-twinned, weakly zoned sodic andesine, untwinned K-feldspar, strongly sutured quartz, chloritized brown biotite, magnetite, and rounded (detrital?) zircon. This rock can best be described as an ultrametamorphosed gneiss and resembles some of the rocks exposed in the Red Hills and Barrett Ridge.

RS-208: Dark-gray-green quartz-feldspathic hornfels with abundant chloritic and sericitic material. Pale-brown altered biotite remnants and some chlorite nets seem to mimic amphibole cleavage(?). Magnetite abundant, also detrital(?) zircon grains.

RS-211: Medium-grained, somewhat homogenized gneiss. Black and white irregular layers and chloritic "smear" zones. Highly altered plagioclase (calcite, sericite, and clay?), minor K-feldspar, shattered and granulated quartz, and chloritized brown biotite. Resembles some rocks of Red Hills and Mount Abel.

RS-212: Dark gneissic rock that is in part homogenized and "granitic". Even the homogeneous parts have unusual patchy dense aggregates of low-birefringent material in the plagioclase that are quite anomalous for granitic rocks of this area. Biotite is strongly chloritized, and some patches of chlorite and calcite suggest hornblende pseudomorphs (amphibole cleavage mimicked in some).

RS-216: Banded gneissic rock that is in part homogenized. Some pinkish K-feldspar-rich layers resemble RS-200. Generally granoblastic texture of well-twinned sodic andesine, untwinned K-feldspar, strongly sutured and mosaicked quartz, and brown biotite. Green hornblende common in parts; also apatite, sphene, detrital(?) zircon, and magnetite. Some resemblance of RS-216b to homogenized gneiss of Mt. Abel (Ross, 1972a, p. 53).

RS-223: Green-streaked rock with granulated sheared areas wandering through it. Much sericite and chlorite, the latter making smeared surfaces on hand specimen. This rock has the composition of a quartz diorite, but whether it is a sheared granitic rock or a sheared gneiss is not certain.

RS-225: Gray gneissic rock that is much homogenized and bears streaky bands of pinkish K-feldspar reminiscent of RS-216. Basically a granodioritic granofels with highly chloritized brown biotite and a liberal sprinkling of green hornblende. Larger plagioclase crystals (about An<sub>50</sub>) are zoned, and a few show minor oscillatory zoning.

"Non-correlative" core samples

Most of the core samples of basement material can be correlated with various degrees of confidence to some of the outcropping basement or, as in the case of the San Ardo area, can be grouped and treated as formational units. In addition, there are a few samples for which no correlations are known. Some of these have special characteristics that are worth noting.

RS-1: An arkosic breccia containing some granitic fragments several millimeters long that consist of sodic plagioclase, quartz, and chlorite. This sample probably represents sedimentary material very near the basement.

RS-35: Messy, shattered alaskite that seems unlike any of the rocks of the Gabilan Range. Suggestive that Reliz fault (shown just east of RS-35 on sheet 1) is a basement break; shattering of sample could be related to proximity to this fault zone.

RS-46: Dark-green sheared and contorted gneiss(?). Composed of andesine, K-feldspar, abundant quartz, and much red-brown biotite, which is sprinkled with metallic opaque grains and somewhat chloritized. Biotite color and general appearance suggest that this is a metamorphic rock rather than a smeared-up granitic rock. Structural contortion, brecciation, and the location of RS-46 suggest that it may be part of a silver in the Santa Lucia fault zone. It is like some like some of the gneissic rocks of Red Hills and may have been dragged from that region by lateral movement on the San Andreas fault.

RS-67: Gray-green saussuritized and chloritized quartz monzonite to granodiorite that is shattered and granulated. K-feldspar is untwinned and biotite is brown.

RS-69: A strongly shattered and crushed granitic rock (virtually a cataclastic) composed of oligoclase, untwinned K-feldspar, quartz, and olive biotite; also abundant sphene.

RS-118: Sample consists of cuttings that contain quartz monzonite fragments as large as 4 mm composed of zoned andesine, untwinned K-feldspar, quartz, and brown biotite.

RS-123: A fresh felsic quartz monzonite that has clearly zoned sodic plagioclase (even oscillatory zoning in part), untwinned K-feldspar, abundant quartz, olive biotite, and some muscovite. Sprinkles of pyrite may be distinctive for an arkose. Appearance suggests it is from a fault zone.

RS-197: Felsic quartz monzonite, locally red stained and quite unlike the granitic rocks of the La Panza Range area. Composed of zoned oligoclase, grid-twinned K-feldspar, large mosaicked quartz masses, and no recognizable dark minerals. Some calcite aggregates are suggestive of amphibole pseudomorphs. The specimen has an interstitial matrix that suggests a rest liquid that was "quenched", but may also reflect granulation. This rock is low in quartz compared to most granitic rocks in the Salinian block.

RS-224: This rock both physically and modally resembles the alaskite of Barrett Ridge, which was described by Ross (1972a). Alaskitic material of this sort seems to typify the Barrett Ridge slice and to be generally different from the "standard" alaskite found in the La Panza Range and in the related granitic terrane to the northwest.

Samples 35, 67, 69, 118, 123, and 138 all appear to be in or west of a fault zone that seems to separate this terrane from the San Ardo area (sheet 1). With the exception of sample 123, a fresh noncorrelative rock that has almost no correlative value, these rocks are "messy" rocks that contrast with the generally clean granitic samples from the San Ardo area. This provides the very tenuous suggestion that this fault line is a significant basement break.

COMMENTS ON CORRELATIONS

Sheet 1 shows 4 granitic units and 2 metamorphic units for which subsurface samples have been correlated with the outcropping formations named in the explanation. The denser pattern of the double box shows the presently known outcrop area of the unit, and the lighter pattern shows the postulated extent of the unit based on the subsurface samples. The subsurface correlations of the Ben Lomond and Vergeses granitic units have been discussed by Ross and Brabb (1973).

Two of the wells (RS-21, 27) drilled south of the Gabilan Range contain material that seems to be correlative with the quartz diorite and granodiorite of Johnson Canyon. This unit and the possibly correlative Vergeses unit have much in common with the rather extensive hornblende-bearing quartz diorite and granodiorite of the San Ardo area. This suggests that an irregularly continuous formation or family of closely related bodies extends for more than 120 km along the east side of the Salinian block.

The known extent of the granodiorite and quartz monzonite of the La Panza Range is greatly increased by the well core data. This distinctive, felsic, porphyritic rock has been identified in the subsurface at several points between the La Panza Range and the San Ardo oil field area. Other basement units could also be present in that sparsely sampled interval, but the La Panza unit presumably extends for a distance of 90 km in this region. Previously noted (Ross, 1972b) is the strong physical resemblance between the granodiorite of Gloria Road in the Gabilan Range and the La Panza unit. If this correlation is valid, the La Panza granitic formation is exposed discontinuously for a distance of about 150 km. Both the Johnson Canyon and La Panza formations seem to provide solid evidence for the continuity of the central granitic core of the Salinian block.

The known extent of the gneissic terrane of the Red Hills and Barrett Ridge is considerably increased to the south-east by core sample material. Even though significant gaps exist in the subsurface data, there is good reason to suppose that these rocks form a continuous belt rich in relatively high grade gneissic rocks from Red Hills to the south-east part of the Salinian block—further evidence that the Barrett Ridge slice (Ross, 1972a) may be a real and significant element in the Salinian block.

The schist of Sierra de Salinas has been identified in the subsurface in the San Ardo oil field area, south of the Gabilan Range, and between the Gabilan and Santa Lucia Ranges. In addition a large outcrop of presumably correlative rocks is present in the southern Gabilan Range. The distribution of this unit tends to discourage the idea that large-scale strike slip has occurred along the course of the Salinas Valley, as I and many others have suggested in print (Ross, 1972a; Ross and Brabb, 1973).

NOTE ON GRANITIC CLASSIFICATION IN THIS REPORT

In the past few years, a number of reports and maps dealing with the granitic basement rocks of the California Coast ranges used a scheme for classifying granitic rocks that has both wide and long-term use in western North America (fig. 2a). An international commission on the systematics of igneous rocks recently proposed a new classification of granitic rocks (Streckeisen, 1973) that was designed to provide for better communication between students of granitic rocks throughout the world. As a step in this direction, the modes of core samples of this report are plotted according to this classification on figure 2b. In the interest of continuity, I am retaining, in the present report, the previously used informal names of granitic units based on the old classification system. Presentation of both classifications here may provide exposure to the "new" without undue confusion with the "old".

The conversion to the new international scheme is relatively easy for most rocks of the Coast Ranges granitic terrane (Salinian block): substitute *granite* for *quartz monzonite* and substitute *tonalite* for *quartz diorite*, and most granitic rock units conform to the new classification. Note that the rock names *quartz monzonite* and *quartz diorite* are restricted in the new classification to quartz-poor granitic rocks, which are quite rare in the Salinian block.

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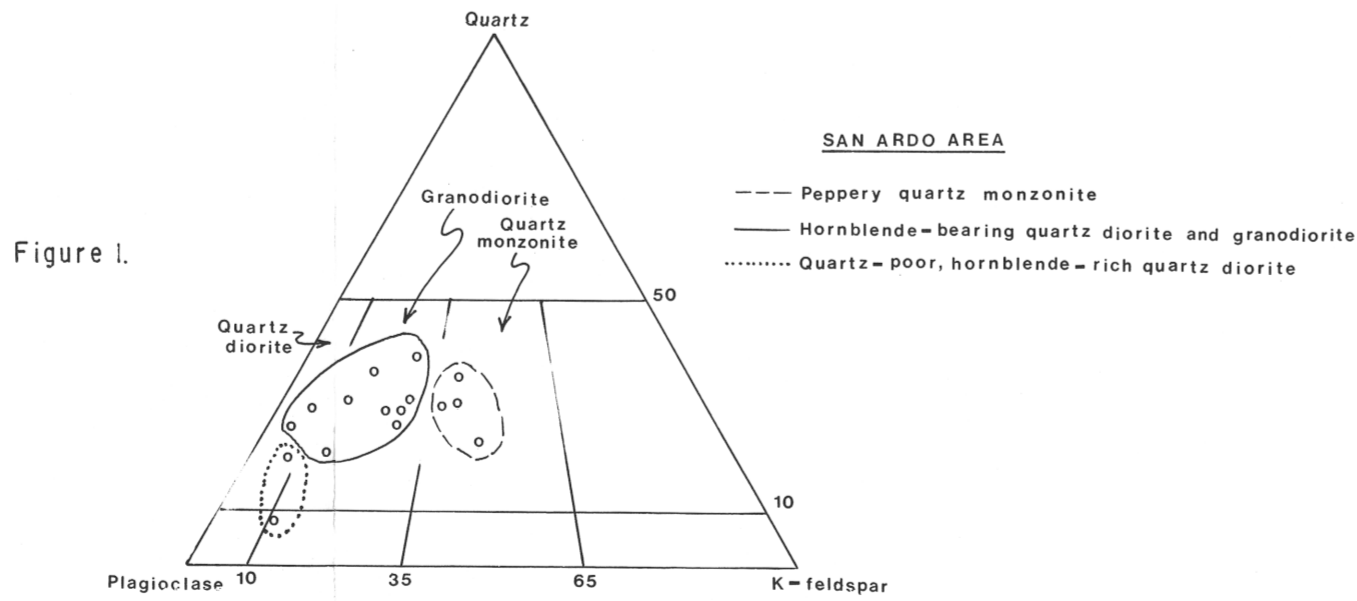


Table 1. WELLS WITH BASEMENT CORE SAMPLES-SALINIAN BLOCK						
Map number	Mt. Diablo Meridian Sec. 7, T. 9, R. 1	Elevation of sample/	Elev. at top of basement (Smith, 1959)	Well name	Operator	
RS- 1	19-108-1E	- 700 to - 710	- 742	Loma Prieta 1	Union Oil Co.	
1	19-118-2W	- 800 to - 813	- 762	L. P. Scaroni et al. 1	Humble Oil and Refining Co.	
14 2/	27-188-6E	-5241 to -5261	-5058	Capital C-1	Union-Cin.	
21 2/	8-198-7E	-2613 to -2623	-2593	Kenner 1	Standard Oil Co. of California	
22	26-198-7E	-1440 to -1450	-1412	Cowles 1 (OH)	"	
27	2-198-9E	- 833 to - 843	- 757	Eade 3-2	"	
30	33-198-9E	+ 658 to + 659	+ 662	U.S.L. 1 Core Hole	"	
35 2/	33-198-10E	-4277 to -4287	-4277	3 Mee	Union Oil Co.	
43A	11-208-10E	-4766 to -4768	-4775	Shell-Texas-Beady 1	Shell Oil Co.	
B		-4768 to -4770		Mee 1	"	
C		-4770 to -4772				
D		-4772 to -4775				
46A	16-208-11E	-2302 to -2332	-2346	Mee 2	"	
B	35-208-11E	-1695	-1695	Bingaman 1	Texaco Inc.	
48A		-1698				
B		-1311	-13427	Etcheberria (NCT-One) 1	"	
62A	33-218-11E	-3606 to -3614	-3602	Keans 1	Union Oil Co.	
67A	8-228-8E	-3624 to -3626				
B		-3634 to -3636				
69	30-228-8E	-4538 to -4548	-4483	Meta E. Oberg et al. 1	Humble Oil and Refining Co.	
81A	12-228-9E	-722 1/2	- 839	Rosenberg 5	Texaco Inc.	
B		-1123	-1172	Biaggio 1	"	
83A	12-228-9E	-1171	-3171	Alice Garrissiere (NCT-2) 1	"	
B		-3199				
C		-3209				
88A	19-228-10E	-1796 to -1806(?) (Sed.)	-1830	Dudley-Grimes-Jorgensen Unit 1	Shell Oil Co.	
B		-1968 to -1978				
C		-1978 to -1988				
92	9-228-10E	-1906	-1909	Gabilan Front C.H. 2	Texaco Inc.	
94A	13-228-10E	-1008	-1010	Langigan 2	"	
B		-1116				
96A	23-228-10E	-1253	-1240	Langigan 1	"	
B		-1258				
99	25-228-10E	-1535 to -1541	-1391	A. Orradre et ux. 1	Humble Oil and Refining Co.	
108A	31-228-10E	-3255(?) -3260(?)	-3260(?)	Aurignac 3	Texaco Inc.	
109	33-228-10E	-3419	-3261	Aurignac 30	"	
B		-3268				
110	5-228-11E	-1189 to -1198	-1084	25-5 Halm-Sump-Orradre	Shell Oil Co.	
114A	19-228-11E	-1402	-1334	Adrian Orradre 1	Texaco Inc.	
B		-1408				
118 2/	13-238-8E	-2009	-1374	Gladys Stocdale 1	Humble Oil and Refining Co.	
123	19-238-9E	-1298 to -1305	- 160	Floyd L. Patterson et al. 1	"	
128A	26-238-9E	-4657(?)	-4655	Hall 1	Texaco Inc.	
B		-4662				
129A	5-238-10E	-5935	-5933	Aurignac 28	"	
B		-5965				
130	6-238-10E	-6824 to -6826	-6781	San Ardo 6-0-1	Chapman-Cannfield Midway	
131A	5-238-10E	-5405	-?	Aurignac 29	Texaco Inc.	
B		-5412				
133A	6-238-10E	-3081	-3000	B-1 Aurignac	"	
B		-3062				
136 2/	15-238-10E	-2803	-2667	Labarere (NCT-3) 1	"	
138	18-238-11E	-1952 to -1962	-1948	Hasbey 212-18	General Petroleum	
140	9-238-11E	-1773 to -1775	-1765	D-6-3 Alexander	Standard Oil Co. of California	
142 2/	8-238-11E	-1827 to -1833	-1829	Alexander 57-8	"	
147	23-238-11E	-2009	-1946	Wood-Maher-1	Texaco Inc.	
148A	25-238-11E	-2684	-2651	Wood (NCT-1)	"	
B		-2685				
C		-2691				
D		-2693				
156	35-258-11E	-1245 to -1250	-1220	G. G. Martin B (NCT-1) 1	"	
157B	19-258-12E	-4049	-4040	J. Jensen (NCT-1)	"	
C		-4077				
165A	1-268-11E	-1095	-1133	G. G. Martin 1	"	
B		-1169				
173A	15-278-14E	-2838	-2859	C. W. Clarke 1	"	
B		-2860				
181 2/	17-298-17E	-4673	-3740	Warden	Union Oil Co.	
182	13-308-17E	-6796 to -6816	-6730	Ferguson 41-13	Shell Oil Co.	
184A	32-308-18E	-1567	-1518	4 Grayson-Owen NCT-1	Texaco Inc.	
B		-1636				
C		-1637				
187	26-318-18E	-4148	-4159	2 Santa Margarita Two NCT-1	"	
194	33-318-19E	-2877 to -2885	-1815	Claude Arnold et al. 2	Humble Oil and Refining Co.	
195 2/	33-318-19E	-2976 to -2996	-2966	Blakey 1	Atlantic Richfield Co.	
197	20-318-20E	- 529	- 502	Blakey 1	Texaco Inc.	
198A	5-328-19E	+ 215	+ 620	1 Santa Margarita Two	"	
B		+ 213				
200	14-328-19E	-2681 to -2691	-1364	Greer-Chimenes 22-14	Atlantic Richfield Co.	
208	2-11N-28W	below -3368?	-3368	Gov't. 17	Superior Oil Co.	
211	11-11N-28W	-3908 to -3916	-3662	Ritter C-21	Atlantic Richfield Co.	
212A	14-11N-28W	-2998 to -3018	-3077	64-14 Joyce B	"	
B		-3018 to -3028				
C		-3072 to -3082				
216A	19-11N-27W	-5473	-5465	Mackie 1	Shell Oil Co.	
B		-5476				
C		-5498				
D		-5503				
220	22-108-23W	-1192 to -1202	- 922	Ramsey 1	Atlantic Richfield Co.	
223	10-9N-24W	-2075	-2201	1 Blue Diamond	Texaco Inc.	
224	24-9N-24W	+ 660 to + 650	+ 683	A-2 Gilbergh	Atlantic Richfield Co.	
225	31-9N-23W	+1296 to +1286	+1753	1 Gilbergh	"	